

Analysis on the impact on air quality of a ban on the sale of bituminous coal in Ireland

PM_{2.5}

PM_{2.5} or 'fine' particulate matter is particle pollution made of a mixture of solids and liquids of size 2.5 µm or less. PM_{2.5} can be emitted directly into the atmosphere or can be formed secondarily. PM_{2.5} is considered a better indicator of man-made particulate matter than PM₁₀.

EPA funded research in Ireland such as the SAPPHIRE project and the AEROSOURCE project has highlighted the predominant source of PM_{2.5} in Ireland's towns and cities comes from the burning of solid fuel.

Figure 1 shows the average PM_{2.5} values at background stations in cities and towns for each year from 2009 to 2019 (year to date). Measurements made at towns with smoky coal bans are compared with those made at towns without smoky coal bans. With the pollutant PM_{2.5} it is more clear that towns without smoky coal bans show higher levels of PM_{2.5} than those with smoky coal bans. Over the period, concentrations of PM_{2.5} are on average 14% higher in towns without a smoky coal ban compared to towns with a smoky coal ban (including Cork and Dublin). However, concentrations are on average 20% higher over the period in towns without a smoky coal ban when compared to Cork and Dublin only.

Since monitoring of PM_{2.5} began at Enniscorthy in 2018, it had the highest observed concentrations of this pollutant among all monitoring stations in Ireland.

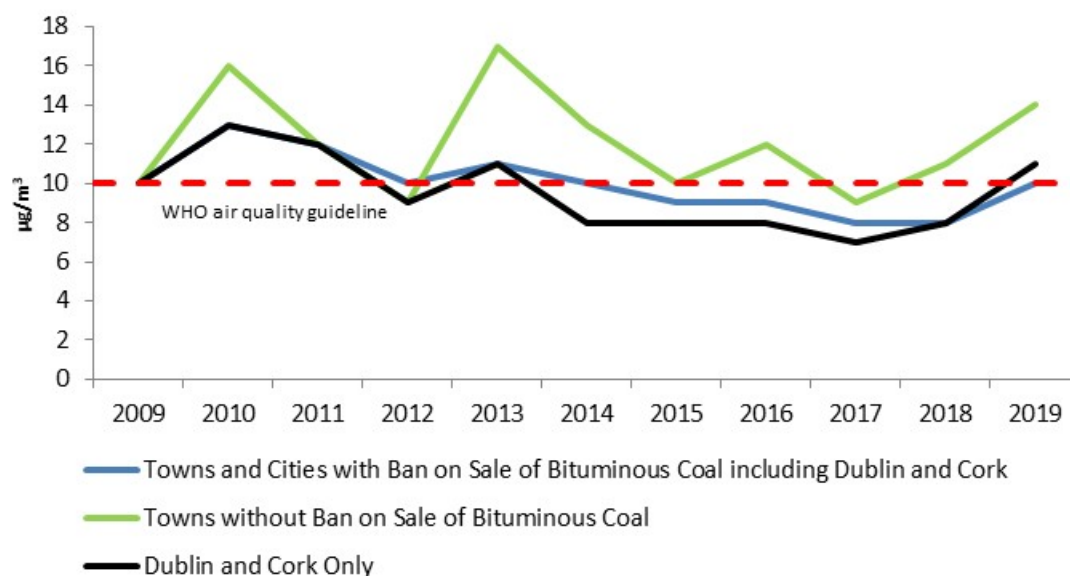


Figure 1 Annual average PM_{2.5} levels in towns and cities with a smoky coal ban and those without 2009 - 2019¹

¹ 2018 monitoring consists of monitoring from 01/09/2018 to 31/12/2018 and 2019 monitoring consists of monitoring from 01/01/2019 to 25/03/2019

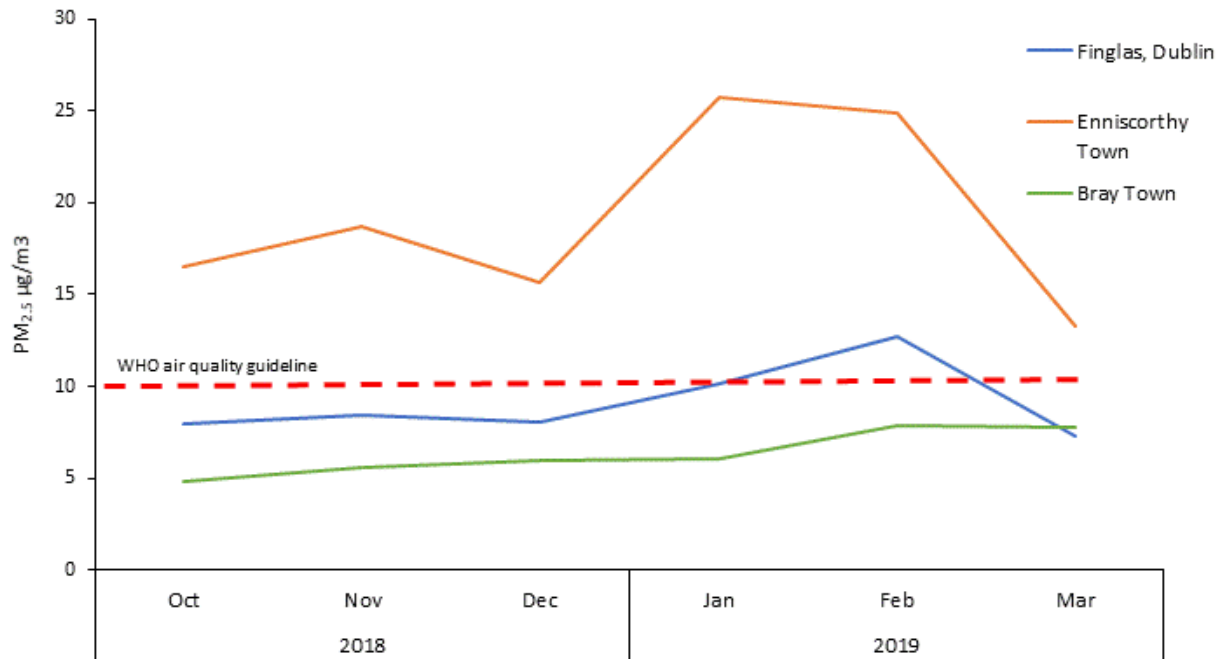


Figure 2 PM_{2.5} concentrations at selected monitoring sites during 2018/2019 winter heating season

Figure 2 shows monthly averaged PM_{2.5} concentrations at selected monitoring sites during the 2018/2019 winter heating season. As is evidenced by this graph concentrations at Enniscorthy which has no ban on the sale of bituminous coal, can be upwards of double the concentrations observed at the monitoring site in Finglas, Dublin and in Bray, Wicklow during this period, both of which have a ban on the sale of bituminous coal.

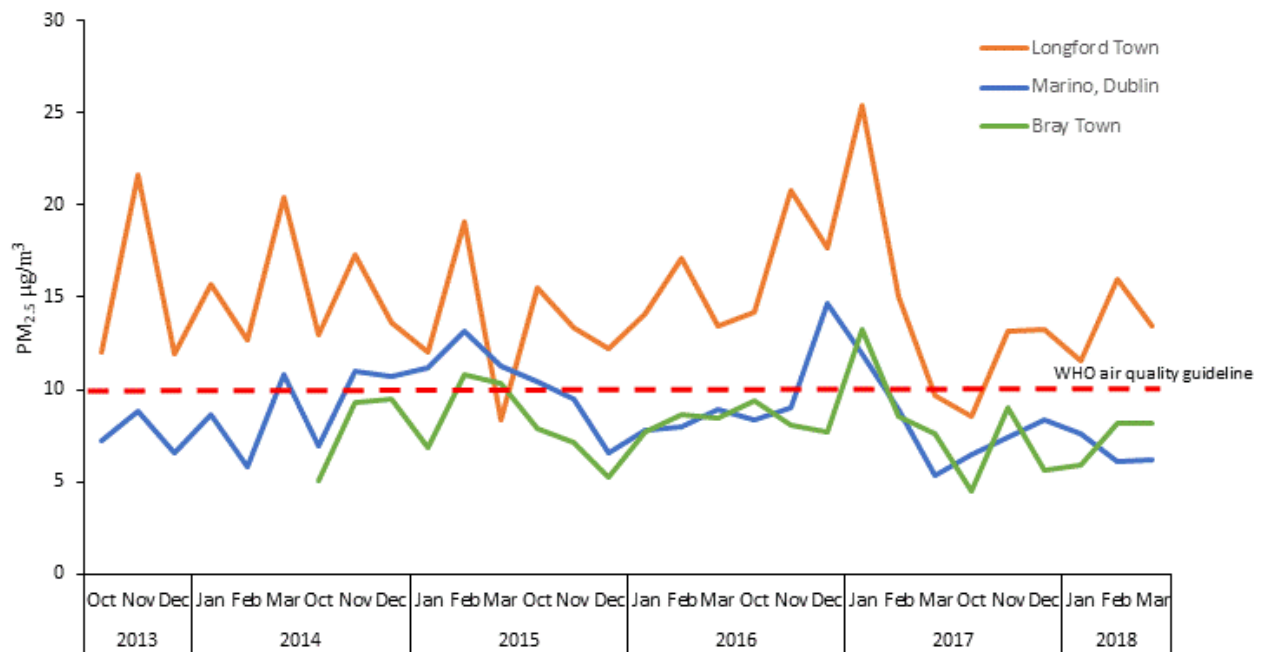


Figure 3 Monthly averaged $PM_{2.5}$ concentrations at selected monitoring sites for the winter heating seasons 2013/2014 to 2017/2018

Figure 3 shows monthly averaged $PM_{2.5}$ concentrations at selected monitoring sites for the winter heating seasons 2013/2014 to 2018/2019. Over this period concentrations at Longford Town which does not have a ban on the sale of bituminous coal have consistently being higher than observed concentrations at the monitoring sites in Marino, Dublin and in Bray, Wicklow, both of which have a ban on the sale of bituminous coal.

PM_{10}

PM_{10} are particles with diameters of 10 μm or less. These particles can consist of direct emissions such as dust, emissions from combustion engines, emissions from the burning of solid fuels or natural sources such as windblown salt, plant spores and pollens. These direct emissions are known as primary PM_{10} . PM_{10} can also be produced indirectly by formation of aerosols as a result of reactions of other pollutants such as NO_x and SO_2 ; these are known as secondary PM_{10} .

Figure 3 shows the average PM_{10} values at background stations in cities and towns for each year from 2004 2019 (year to date). Measurements made at towns with smoky coal bans are compared with those made at towns without smoky coal bans. In general, the towns without coal bans show higher levels of PM_{10} than those with bans. Over the period concentrations of PM_{10} are on average 6% higher in towns without a smoky coal ban compared to towns with a smoky coal ban (including Cork and Dublin). However, concentrations are on average 12% higher over the period in towns without a smoky coal ban when compared to Cork and Dublin only.

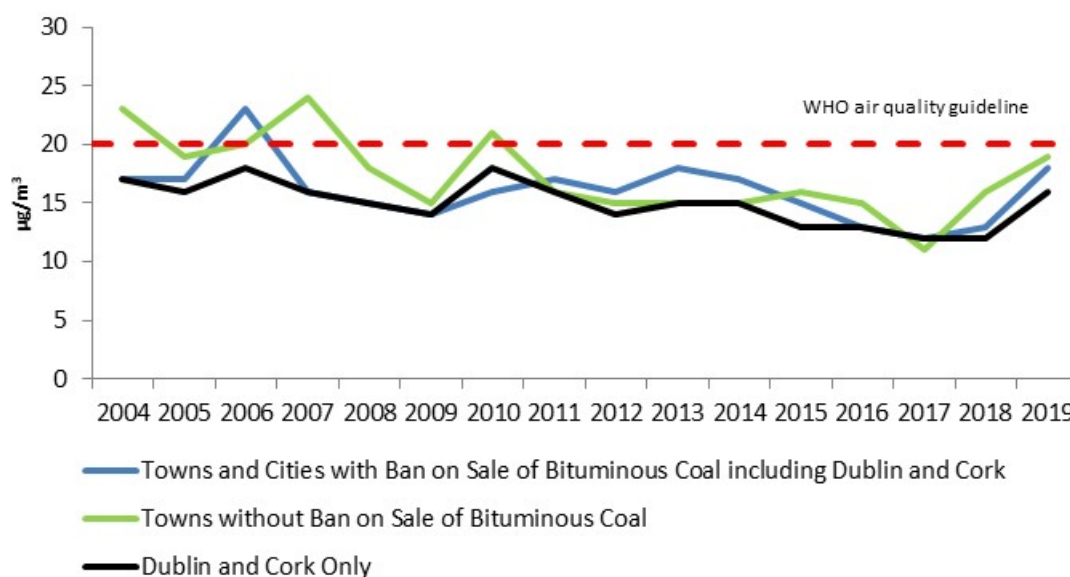


Figure 4 Annual average PM_{10} levels in towns and cities with a smoky coal ban and those without 2004 - 2019²

To date in 2019 Enniscorthy, a town without a ban on the sale of bituminous coal has the most number of exceedances of the $50 \mu\text{g}/\text{m}^3$ daily limit value (nine) with three locations having the next most exceedances (five). Enniscorthy has also had the highest average PM_{10} concentrations amongst monitoring locations in 2018 and 2019.

The greatest impact of the ban on the sale of bituminous coal is seen in Dublin and Cork. The length of time since the ban in these cities along with the large size of the restricted areas means residents are accustomed to not using bituminous coal and are unlikely to travel outside the area to purchase it. The availability of natural gas also reduces the amount of solid fuel used for domestic heating.

The data for the towns with bans includes such Dublin, Cork, Carlow, Galway, Ennis and Newbridge. While data for towns without a ban comes from locations such as Castlebar, Enniscorthy, Roscommon, Mullingar (pre-ban) and Balbriggan (pre-ban).

Further information on the data used for the graphs in this report is presented in Appendix 1.

It must be noted that much of this analysis has been carried out using data from an air quality monitoring network that was prior to the implementation of the National Ambient Air Quality Monitoring Programme (AAMP) and must be understood in that context. With the implementation of the AAMP future analysis can draw upon a greatly expanded monitoring network with increased access to real-time particulate matter information.

² 2018 monitoring consists of monitoring from 01/09/2018 to 31/12/2018 and 2019 monitoring consists of monitoring from 01/01/2019 to 25/03/2019

Conclusion

Continuing emissions from domestic solid fuel use are contributing to high levels of particulate matter in villages, towns and cities. We are above the WHO air quality guideline value for PM_{2.5} at many locations at which we monitor. The proposed extension of the ban on smoky coal will have a positive impact on levels of particulate matter particularly in rural towns and villages.

Appendix 1

Year	Average PM _{2.5} concentrations in towns and Cities with ban on the sale of Bituminous Coal including Dublin and Cork	Standard deviation in concentrations of towns and cities with ban	Average PM _{2.5} in towns without Ban on Sale of Bituminous Coal	Standard deviation in concentrations of towns and cities without ban	Average PM _{2.5} in Dublin and Cork Only	Percentage difference towns without ban / towns with ban	Percentage difference towns without ban / Dublin & Cork
2009	10	0.5	10	0.0	10	0%	0%
2010	13	2.0	16	0.0	13	19%	19%
2011	12	0.5	12	2.5	12	0%	0%
2012	10	1.2	9	0.0	9	-11%	0%
2013	11	0.8	17	0.0	11	35%	35%
2014	10	3.5	13	0.0	8	23%	38%
2015	9	2.0	10	0.0	8	10%	20%
2016	9	1.9	12	0.0	8	25%	33%
2017	8	2.3	9	0.0	7	11%	22%
2018	8	1.4	11	1.9	8	27%	27%
2019	10	1.5	14	4.9	11	29%	21%
Average percentage difference 2009 - 2019						14%	20%

Table 1 Average PM_{2.5} in Towns and Cities with and without a ban on the sale of bituminous coal

Year	Towns and Cities with ban on the sale of Bituminous Coal including Dublin and Cork used for calculation of Table 1	Towns without Ban on Sale of Bituminous Coal used for calculation of Table 1
2009	Dublin Cork	Ennis
2010	Dublin Cork	Ennis
2011	Dublin Cork	Ennis Longford
2012	Dublin Cork Ennis	Longford
2013	Dublin Cork Ennis	Longford
2014	Dublin Cork Ennis Bray	Longford
2015	Dublin Cork Ennis Bray	Longford
2016	Dublin Cork Ennis Bray	Longford
2017	Dublin Cork Ennis Bray	Longford
2018	Dublin Cork Carlow Bray	Longford Cobh Enniscorthy Roscommon
2019	Dublin Cork Carlow Bray	Longford Cobh Enniscorthy Roscommon

Table 2 Towns and Cities with and without a ban on the sale of bituminous coal used to calculate Table 1

Year	Average PM ₁₀ concentrations in towns and Cities with ban on the sale of Bituminous Coal including Dublin and Cork	Standard deviation in concentrations of towns and cities with ban	Average PM ₁₀ in towns without Ban on Sale of Bituminous Coal	Standard deviation in concentrations of towns and cities without ban	Average PM ₁₀ in Dublin and Cork Only	Percentage difference towns without ban / towns with ban	Percentage difference towns without ban / Dublin & Cork
2004	17	2.1	23	3.0	17	26%	26%
2005	17	5.9	19	4.5	16	11%	16%
2006	23	5.9	20	4.5	18	-15%	10%
2007	16	1.5	24	8.0	16	33%	33%
2008	15	0.5	18	2.0	15	17%	17%
2009	14	0.8	15	1.4	14	7%	7%
2010	16	1.9	21	4.3	18	24%	14%
2011	17	1.7	16	4.0	16	-6%	0%
2012	16	2.1	15	2.2	14	-7%	7%
2013	18	2.6	15	0.0	15	-20%	0%
2014	17	2.4	15	5.0	15	-13%	0%
2015	15	2.5	16	2.5	13	6%	19%
2016	13	2.4	15	2.5	13	13%	13%
2017	12	2.3	11	0.0	12	-9%	-9%
2018	13	2.7	16	2.9	12	19%	25%
2019	18	3.0	19	5.0	16	5%	16%
Average percentage difference 2004 - 2019						6%	12%

Table 3 Average PM₁₀ in Towns and Cities with and without a ban on the sale of bituminous coal

Year	Towns and Cities with ban on the sale of Bituminous Coal including Dublin and Cork used calculation of Table 3	Towns without Ban on Sale of Bituminous Coal used for calculation of Table 3
2004	Dublin Cork Tralee	Mountrath Clonmel
2005	Dublin Cork Wexford Kilkenny	Mountrath Castlebar
2006	Dublin Cork Wexford Bray	Ennis Ferbane Castlebar
2007	Dublin Cork	Ennis Ferbane Navan Castlebar
2008	Dublin Cork	Letterkenny Castlebar
2009	Dublin Cork Newbridge	Letterkenny Castlebar Ennis
2010	Dublin Cork Galway Bray Celbridge	Ennis Longford Castlebar Newbridge
2011	Dublin Cork Galway Ennis Bray	Castlebar
2012	Dublin Cork Galway Ennis Bray	Castlebar Balbriggan Mullingar
2013	Dublin Cork Galway Ennis Bray	Castlebar Mullingar
2014	Dublin Cork Galway Ennis Bray	Castlebar Mullingar Enniscorthy
2015	Dublin Cork Galway Ennis	Castlebar Enniscorthy
2016	Dublin Cork Galway Ennis Portlaoise	Castlebar Enniscorthy
2017	Dublin Cork Ennis	Castlebar

	Portlaoise	
2018	Dublin Cork Carlow Dundalk Kilkenny Portlaoise	Castlebar Enniscorthy Roscommon
2019	Dublin Cork Carlow Dundalk Kilkenny Portlaoise Waterford	Castlebar Enniscorthy Roscommon Cobh

Table 4 Towns and Cities with and without a ban on the sale of bituminous coal used in this assessment